THE POWERED ROLL GIN STAND
A GIN'S PERSPECTIVE

James W. Askew - Servico, Inc., Courtland, AL
Greg A. Holt and J. Weldon Laird - USDA-ARS, Lubbock, TX

Abstract

Upon the successful installation and evaluation of the first commercial powered roll gin stand (PRT gin stand) in 2002, three commercial PRT gin stands were installed and operated during the 2003 gin season. Several mechanical problems were encountered with the new gin stands, and were corrected during the course of the gin season. Gin turnout results in 2003 were shown to verify the results obtained during the 2002 tests. Gin production rates were subjectively determined to be higher than those of previous years due to the efficient operation and higher capacity tendencies of the PRT gin stands.

Introduction

Servico, Inc. agreed to cooperate with the USDA-ARS in 2002 in the installation and operation of the first commercial powered roll gin stand (PRT gin stand). Servico personnel had gained experience with the operational concepts of the PRT gin stand by operating the original, smaller versions of the PRT gin stand in their Easiflo facility. The Easiflo process involves the removal of seed tails from fuzzy cottonseed, followed by the mixing of a hot slurry of corn starch and water onto the tailless cottonseeds. After the mixing process, the coated cottonseeds are dried and cooled, resulting in a product with flowability characteristics similar to grain products. The seed tail removal portion of this process utilizes small PRT gin stands to gin the tails off of the seeds.

The USDA-ARS Lubbock ginning laboratory decided to test the concept of ginning seed cotton on a PRT gin stand in the fall of 2001. The results of the laboratory tests indicated improved fiber quality parameters and turnout (Laird, et. al., 2002). The laboratory tests were conducted on a modified Continental 90 saw gin stand with 12-inch diameter saws. The modifications included the installation of narrower ribs and increasing the number of saws to 116. The positive results led to the agreement with Servico, Inc. to install and operate the first commercial PRT gin stand for the 2002 gin season.

The PRT gin stand develops and maintains a seed roll by the interaction of a counter-clockwise rotating gin saw and a clock-wise rotating power roll cylinder, when viewed from the gin stand's left end (Figure 1). The aluminum seed fingers move in between the gin saws when the gin breast moves to the 'in' position. They rotate in a counter-clockwise direction. As ginned seed falls between the gin saws, the majority of seeds are exposed to the seed fingers. The interaction of the seed fingers and the seeds allows the gin saw to capture and re-introduce back into the seed roll any seeds that still have lint tails attached. The remaining seeds continue past the seed fingers into the seed conveyor auger.

The 2002 test stand was placed in the third position of the three stand Continental Double Eagle 141 plant. The stand was dimensionally modified four times to achieve the performance levels of the modified laboratory Continental gin stand. Once the modifications were complete, the test stand ginned 12,500 bales alone. During ginning, it was determined that the rib rail was not structurally sound enough to handle the internal pressures of the stand. The rib rail was stiffened and no further mechanical problems were experienced with the stand. After determining optimum PRT gin saw, power roll and seed finger speeds (rpm's), fiber properties were evaluated simultaneously against the Double Eagle 141 stands. It was shown that the PRT stand produced a higher percentage of fibers longer than one inch (Figure 2). It was also shown that upper half mean and uniformity ratio were improved with the PRT stand (Laird, et. al., 2003).

Further tests on the 2002 test stand resulted in favorable gin turnout results (Table 1). An average increase in gin turnout of 31 pounds per bale resulted when operating the PRT stand. Tests were also conducted to determine the bale per hour capacity of the PRT stand. It was shown that the stand could gin up to 17 bales per hour. However, the structural integrity of the rib rail was questionable, so tests were discontinued at

this speed. No lint samples were drawn while running the capacity tests. Therefore, no conclusions were made regarding ginning capacity versus lint fiber quality.

Results

Based on the positive results of the 2002 PRT test, Servico, Inc. decided to install new, commercial model PRT stands in all three gin stand positions in 2003. Overall, gin production and turnout were favorable, while several structural weaknesses resulted in more gin downtime than anticipated. The mechanical problems experienced were: numerous power roll drive shaft breakages, twisting of rib rail resulting in the relocation of gin rib positions, power roll flaps breaking from power roll shaft, and power roll drive cog belt breakages. Each of these problems was addressed and resolved during the gin season. The power roll drive shaft breakages were corrected by installing stronger stand-offs for the drive shaft bearings (Figure 3). The twisted rib rails were moved back into position and welded at each end to assist the originally installed bolts in the support role (Figure 4). Gussets were installed between power roll flaps to enhance the structural integrity of the entire power roll (Figure 5). Cog belts internally lined with Kevlar material were installed to prevent premature breakage of the belts.

During the first two weeks of ginning in 2003, the amperage on the gin stand's saw motors was noted to be fluctuating badly (30-50 amps), an occurrence that was not seen in 2002. Additionally, the gin stands didn't seem to be cleaning the seed as efficiently as they had in 2002. These concerns led to the discovery that some of the internal gin stand dimensions were too big. The power roll cylinder's overall diameter was approximately ¾" larger, and the seed roll box dimension from the power roll flaps to the front door scroll was ¾" farther than the 2002 test stand's. The power roll flaps were trimmed to the proper diameter and the roll box was modified with sheet metal scrolls to acquire the proper internal dimension. Once these changes were completed, the saw amperages and seed cleaning efficiencies were similar to those recorded on the 2002 test stand.

Gin stands #1 and #3 were set up to run at the optimized cylinder speeds determined on the 2002 test stand. These speeds were optimized on staple length and short fiber content. They were 720 rpm (gin saw), 29 rpm (seed fingers) and 215 rpm (power roll). Once the dimensional issues on the 2003 stands were corrected, samples were taken from the #2 gin stand line with the power roll running at varied speeds. Gin stand #2 is equipped with a 30 horsepower variable frequency drive (VFD) to allow for continued testing of the PRT stands. Tables 2 and 3 show the results of the variable power roll speed tests. These results helped to confirm the 2002 optimization that the 215 rpm (217 in table) power roll setting was an acceptable speed. Also shown are lint residual results on seed samples taken simultaneously with the fiber samples. The preliminary field trial, conducted this season, indicates that running the power rolls at 184 rpm could result in better lint turnouts along with favorable fiber qualities.

As mentioned earlier, downtimes associated with the PRT gin stands were higher than anticipated due to structural failures, and were resolved during the course of the season. However, there was no gin stand downtime due to gin rib tags, rib fires or digging out seed rolls in 2003 (Table 4). This is a tremendous result when compared to the downtimes experienced for similar reasons in the 2001, 2002 ginning seasons. The upward wiping motion of the power roll against the tops of the gin ribs appeared to eliminate the formation of rib tags, even on stripper cotton or wet or rotten cotton. Additionally, the PRT stand's gin saws remained in better condition for similar ginning volumes than in previous years. Even at the end of processing, saw teeth were intact with minimal damage. The power roll working in conjunction with the gin saw to develop and maintain the seed roll reduces the workload on the saws, resulting in longer saw life. Whenever it was necessary to change out an entire saw cylinder, the time required to do so was approximately 60% of that required on the conventional stand. The mechanical simplicity of the PRT stands was evident not only when running the stands, but also when conducting jobs such as saw cylinder changes.

Seed warehouse capacity increased in 2003 because increased gin turnout resulted in less lint going into the seed warehouse. Another noticeable benefit in the warehouses was less fuzz on the ceilings and rafters.

Simple observation of the gin plant's operation during the 2003 season indicated an increase in overall production rates. Monitoring of the control screen and reviewing production reports from the 2001-2003 seasons resulted in an estimated average ginning capacity increase on dry harvest cotton of 37-39 bales per hour in 2003 versus 36-38 bales per hour in 2001 and 2002.

Furthermore, 49.4% (40 of 81) days resulted in more than 700 bales ginned in 2003. Whereas, 33.8% (22 of 65) days resulted in more than 700 bales ginned in 2002 (PRT testing days excluded), and 27.7% (28 of 101) days resulted in more than 700 bales ginned in 2001. The gin repair program was consistent for each of the 2001-2003 repair seasons. Except for crop condition variations (2001 and 2003 harvests were dry with good quality fiber, 2002 harvest was damp with lower quality fiber), the only difference from a ginning standpoint was the PRT gin stands.

Moreover, the 2003 average ginning rate, with all downtime events and all poor incoming cotton conditions included, was 29.2 bales per hour. The 2002 and 2001 average ginning rates, with all events and conditions included, were 26.4 and 26.6 bales per hour, respectively. This shows that overall gin performance was better, once again, in 2003. What makes this even more interesting is that the 2003 ginning season resulted in at least 3% more total gin downtime than either of the previous two seasons, partly because of the PRT structural problems. This means that when the gin and the gin stands were running, they were running very effectively.

A comparison was also performed on the average gin turnout for the 2001 and 2002 crops versus the gin turnout for the 2003 crop. The 2001 and 2002 average turnout was 1399 pounds lint per 500-pound bale produced (35.7% turnout). The 2003 turnout was 1320 pounds of lint per 500-pound bale produced (37.8% turnout). Both results include only first and second picked cotton. The resulting benefit to the farmer equates to an increase of 2.1% more lint per bale ginned. This result, in a more broad sense, validates the increased turnout results obtained from the 2002 PRT stand test.

The power requirements of running PRT gin stands at 12-13 bales per hour capacity were determined to be 7.8% higher than the 141 Double Eagle's requirements at the same capacity (12-13 bales per hour was typical operating capacity of Servico's 141 Double Eagles). During the 2002 test, it was determined that at approximately 12.5 bales per hour, the PRT stand and Double Eagle stand drew 75 and 90 amps, respectively. The PRT stand's 30 horsepower power roll motor drew 22 amps at the same capacity. Therefore, the total PRT stand requirement was 97 amps. However, during the 2003 ginning season, it was observed that relatively slight increases in power roll motor amperages would result in higher ginning rates. Due to time constraints, we were not able to determine how many bales per hour the PRT stands could actually produce. The ginning rate, whereby the additional power consumption cost will be offset by the benefit of increased capacity, turnout and/or fiber properties, still needs to be determined.

Conclusions

The PRT gin stands produced positive quality, turnout and ginning capacity results during the 2003-ginning season. There was a significant level of downtime because of structural deficiencies in the new stands. These deficiencies were addressed and resolved, or have recommended resolutions for the coming repair season. Further testing will be done regarding the capacity (bales/hr) potential of the PRT stands and the resulting capacity effects on fiber quality.

Disclaimer

Use of a trade name, propriety product or specific equipment does not constitute a guarantee or warranty by Servico, Inc. or the United States Department of Agriculture and does not imply approval of a product to the exclusion of others that may be suitable.

References

Laird, J.W., G.A. Holt, T.C. Wedegaertner, and W.F. Lalor. 2002. Powered Power Roll Gin Stand. Beltwide Cotton Conferences, Atlanta, Ga.

Laird, J.W., G.A. Holt, M. Buser, and J.W. Askew. 2003. Application of Powered Roll Gin Stand Technology to Gin Stands with Large Diameter Saws. ASAE Annual International Meeting, Las Vegas, Nevada.

Table 1. Gin turnout results from 2002 Power Roll gin stand tests.

Module Number	Gin Stand	Raw Cotton (lbs.)	Lint Yield (lbs.)	Lint Turnout (%)	Seed cotton/ 500 lb. bale	Lint Gain by PRT (lb/bale)
12497	CDE	15020	5009	33.35	1499	
	PRT	12100	4332	35.8	1397	**36.7**
14331	CDE	10800	3679	34.06	1468	
	PRT	11500	4132	35.93	1392	**27.4**
14348	CDE	9020	3317	36.78	1360	
	PRT	9980	3878	38.86	1287	**28.3**
14352	CDE	11000	4003	36.39	1374	
	PRT	9800	3800	38.78	1289	**32.8**

Table 2. Mean AFIS parameters versus Power Roll speed. Tests conducted on five modules and three different cotton varieties.

Power Roll (rpm)	L(w) (in.)	UQL(w) (in.)	SFC(w) %<0.50	L(n) (in.)	Nep Cnt/g	Trash Cng/g	VFM %	Lint Residual (Lubbock)
184	**0.98**	**1.17**	**7.9**	**0.81**	**216**	**128**	**2.86**	**1.16**
199	**0.98**	**1.17**	**7.8**	**0.81**	**209**	**126**	**2.66**	**1.37**
217	**0.97**	**1.16**	**8.2**	**0.79**	**210**	**114**	**2.59**	**1.36**
226	**0.98**	**1.17**	**8.1**	**0.8**	**222**	**133**	**2.71**	**1.41**

Table 3. Mean HVI parameters versus Power Roll speed. Tests conducted on five modules and three different cotton varieties.

Power Roll (rpm)	Rd	+b	Leaf	UHM	UNIF	STR	ELG	Lint Residual (Lubbock)
184	**76**	**6.9**	**7**	**1.09**	**82.9**	**27.1**	**6.3**	**1.16**
199	**77**	**6.9**	**8**	**1.08**	**83**	**27.5**	**6.1**	**1.37**
217	**77**	**6.9**	**8**	**1.09**	**83.1**	**26.6**	**6.2**	**1.36**
226	**77**	**7.1**	**9**	**1.09**	**83.4**	**27.1**	**6.1**	**1.41**

Table 4. Downtime related to gin rib tags, rib fires and digging out gin stand seed rolls due to wet or rotten cotton.

Crop Year		Bales Ginned	Gin Stand Downtimes (minutes)	Percent of Total Gin Downtime
2001		64,300	1485	10.4
2002		48,200	870*	12.87*
2003	PRT	54,300	0	0

*- Excluding #3 gin stand location - PRT test stand.

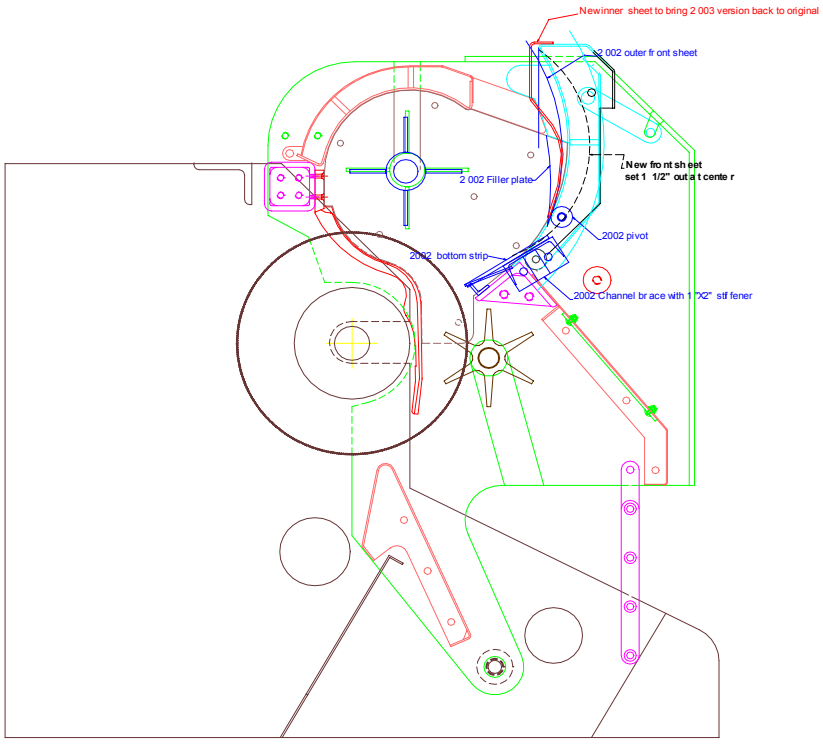

Figure 1. Left end of Power Roll gin stand.

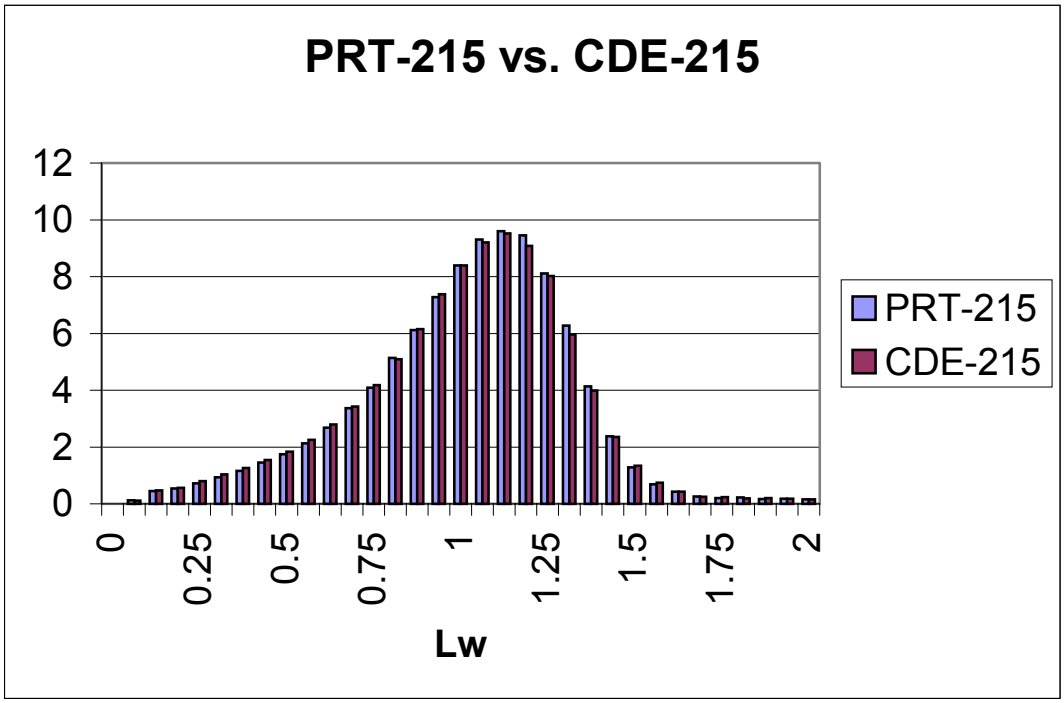

Figure 2. Fiber percentage versus length by weight for tests conducted on PRT and 141 CDE gin stands.

Figure 3. Modified Power Roll bearing stand-off.

Figure 4. Welded Power Roll gin stand rib rail.

Figure 5. Gussets added to Power Roll gin stand power rolls.